

Cyclotron Instability in the Afterglow Mode of Minimum-B ECRIS

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It was shown recently that cyclotron instability in non-equilibrium plasma of a minimum-B electron cyclotron resonance ion source (ECRIS) causes perturbation of the extracted ion current and generation of strong bursts of bremsstrahlung emission, which limit the performance of the ion source. The present work is devoted to the dynamic regimes of such plasma instability in ECRIS operated in pulsed mode. Instability develops in decaying plasma shortly (1 - 10 ms) after heating microwaves are switched off, and manifests itself in the form of powerful pulses of electromagnetic emission associated with precipitation of high energy electrons along the magnetic field lines. Time-resolved measurements of microwave emission bursts related to cyclotron instability in the decaying plasma are presented. The temporal resolution was high enough to study the fine structure of dynamic spectra of electromagnetic emission at different operating regimes of the ion source. It was found that even in various gases (helium, oxygen and argon were studied) and at different values of magnetic field and heating power the dynamic spectra demonstrate common features: decreasing frequency within a single burst as well as from one burst to another. The analysis have shown that instability is driven by the resonant interaction of hot electrons distributed between the ECR surface and the trap center with slow extraordinary wave propagating quasi-parallel to the magnetic field.